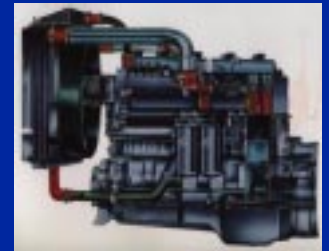




Natural Gas Program



Third National Clean Cities Stateholders Conference and Expo COMMERCIALLY AVAILABLE TRUCK ENGINES

Presented by: John Bartel
Steve Ginter
Don Brugger

June 24 - 26, 1997





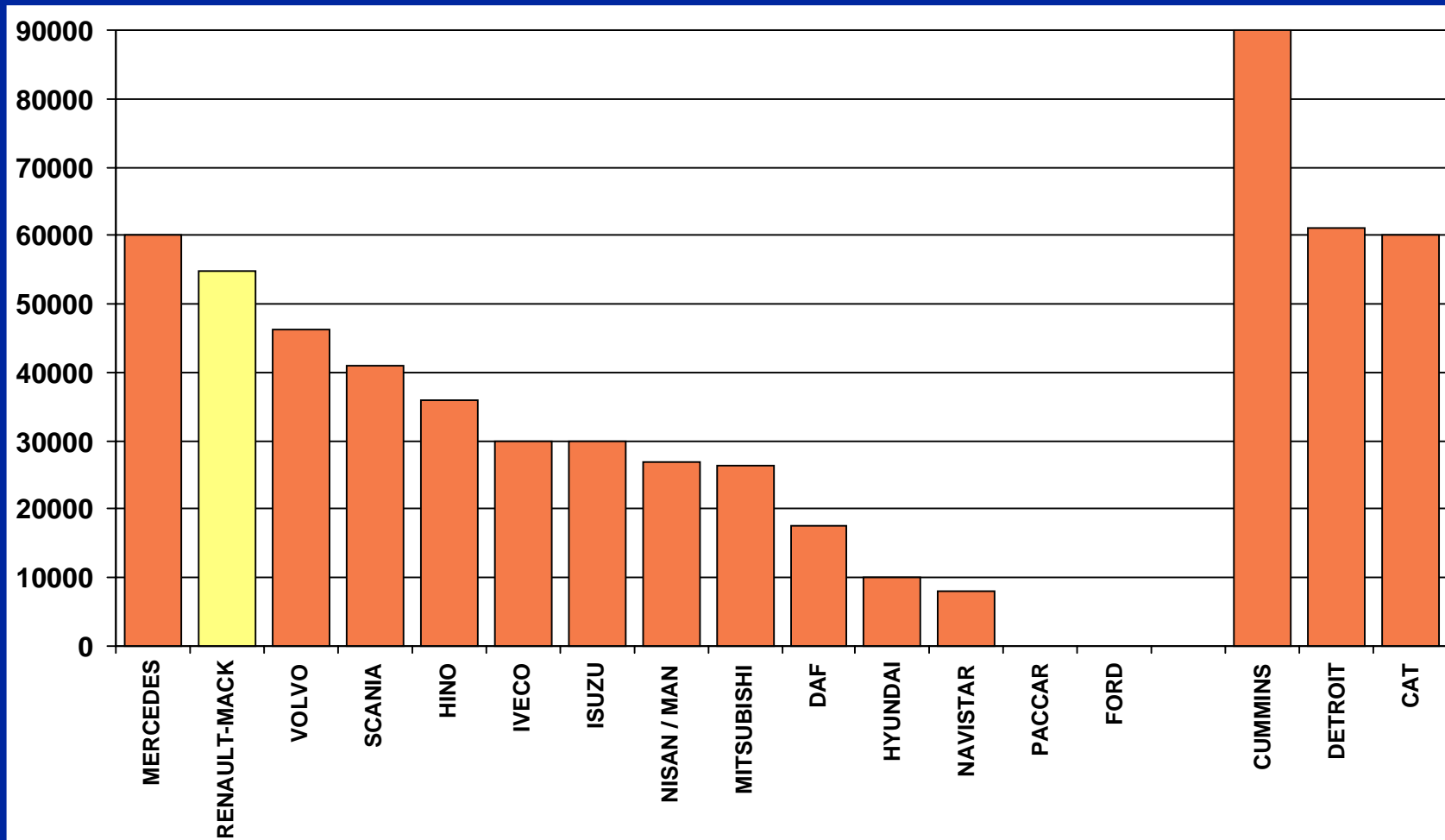
Mack Trucks, Inc. Chassis Manufacturer

INTEGRATED VEHICLE DESIGN

- ▼ **E7 diesel engine**
- ▼ **E7G natural gas engine - CNG or LNG**
- ▼ **Transmissions**
- ▼ **Axles and suspensions**



OVERALL WORLD MARKET ENGINE CLASS 8 - 1995



Source : Renault V.I.

NATURAL GAS SERIES



E7G Engine



LE LNG



MR LNG



FUTURE MR TRACTOR



EPA Emissions Standards

(G/BPH-HR)

.6
Particulate

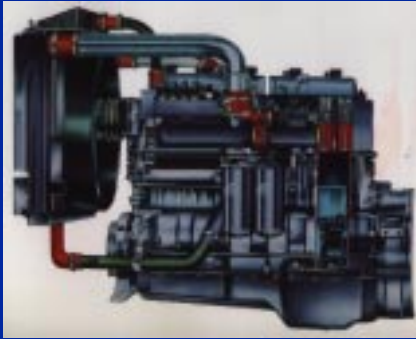
.25

.1

1990	
1991	
1998	1994

Nitrous Oxide



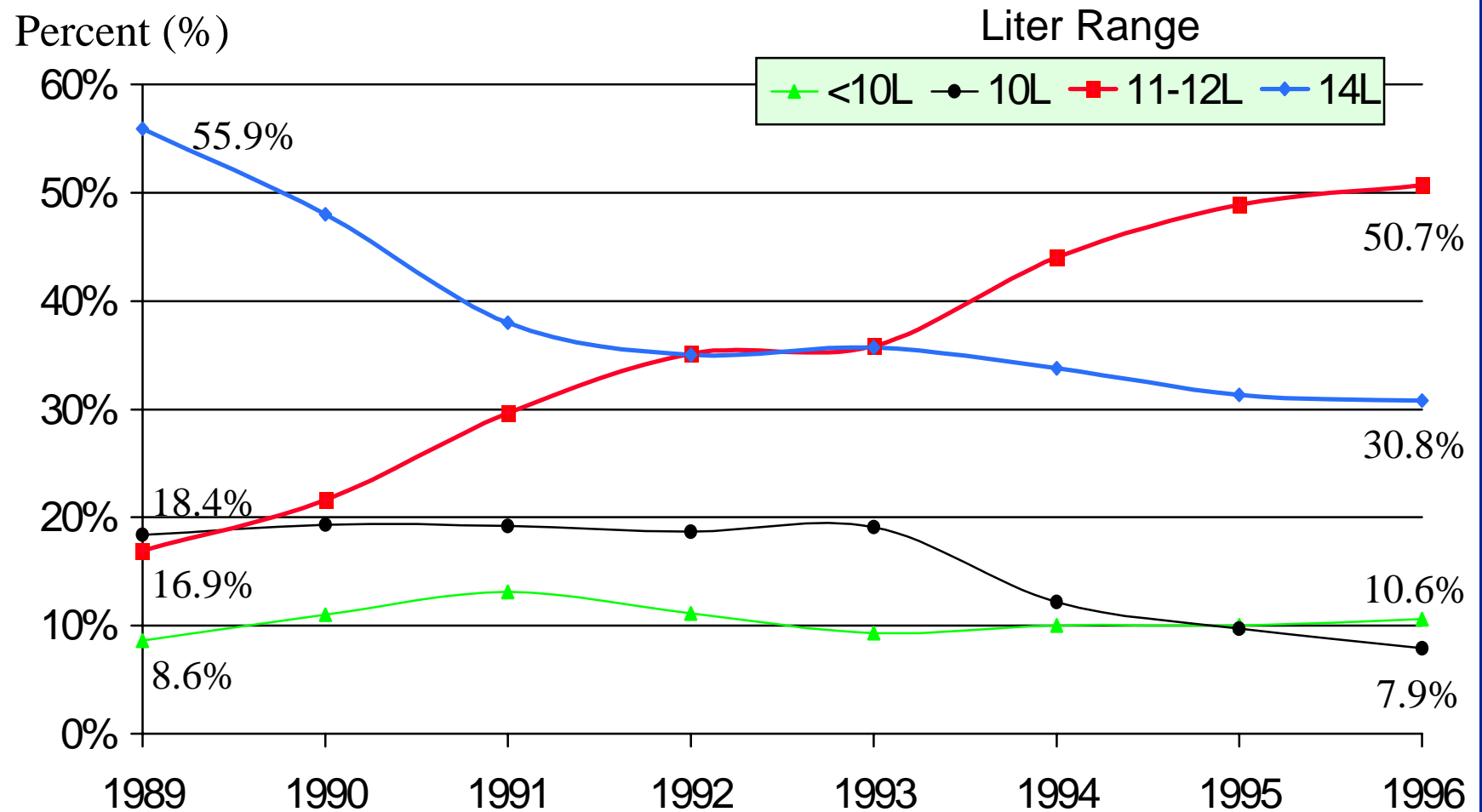


Benefits of Natural Gas Power

- ▼ Low Emissions
- ▼ Reduced Noise
- ▼ Driver Preferred Vehicle
- ▼ Ecological Success/Image
- ▼ Domestic Fuel



OEM - Class 8 - Liter Size 1989 to 1996



Source : R L Polk

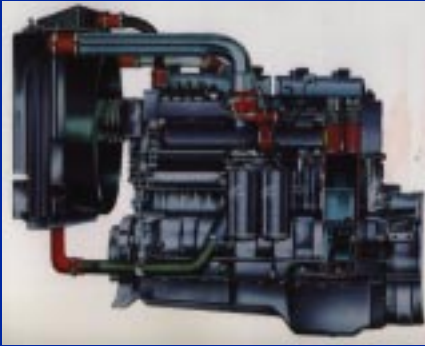


E7G 12L Engine



- ▼ **Engine Operates on 100% Natural Gas**
- ▼ **Can use either CNG or LNG Fuel**
- ▼ **Spark Ignited & Throttled Engine Design**
- ▼ **Excellent Driveability**
- ▼ **Diesel-like Reliability & Durability**
- ▼ **Dynatard Engine Brake Available**





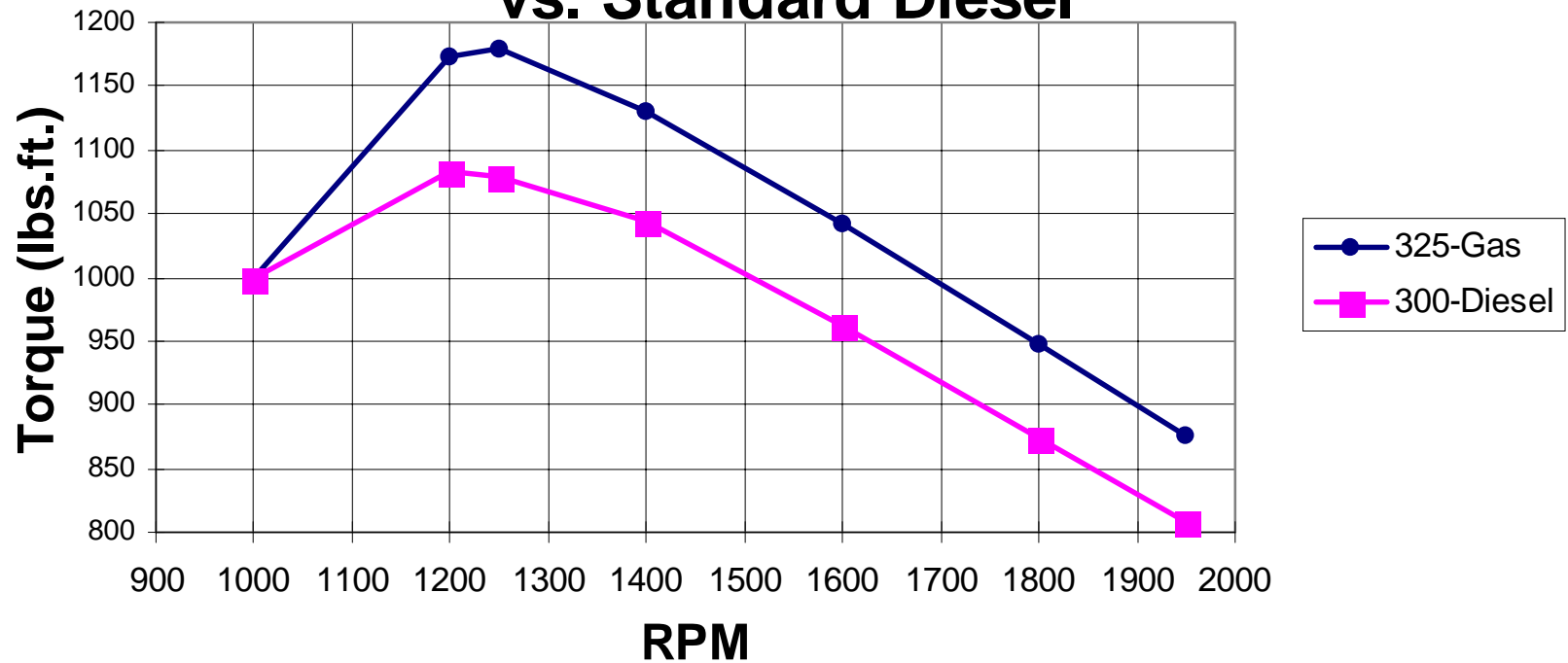
MAC K Engine

- ▼ Power 325 h.p. @ 1950 rpm
- ▼ Torque 1180 lbs. ft. @ 1250 rpm
- ▼ High power and torque for refuse application
- ▼ CNG or LNG
- ▼ Electronically controlled lean-burn



Available Torque

E7G-325 Engine Performance vs. Standard Diesel





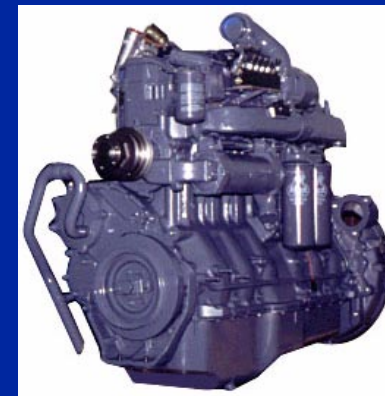
Woodward / MESA Electronic Fuel System

- ▼ Closed-Loop Lean Burn with Adap. Learn
- ▼ Advanced “Turbo-Lag” Compensation
- ▼ Full Authority Electronic Throttle
- ▼ NGK UEGO Sensor
- ▼ Electronic Westgate Control
- ▼ High Energy Inductive Ignition System
- ▼ Full Diagnostics
- ▼ Reduced Power Engine Protection





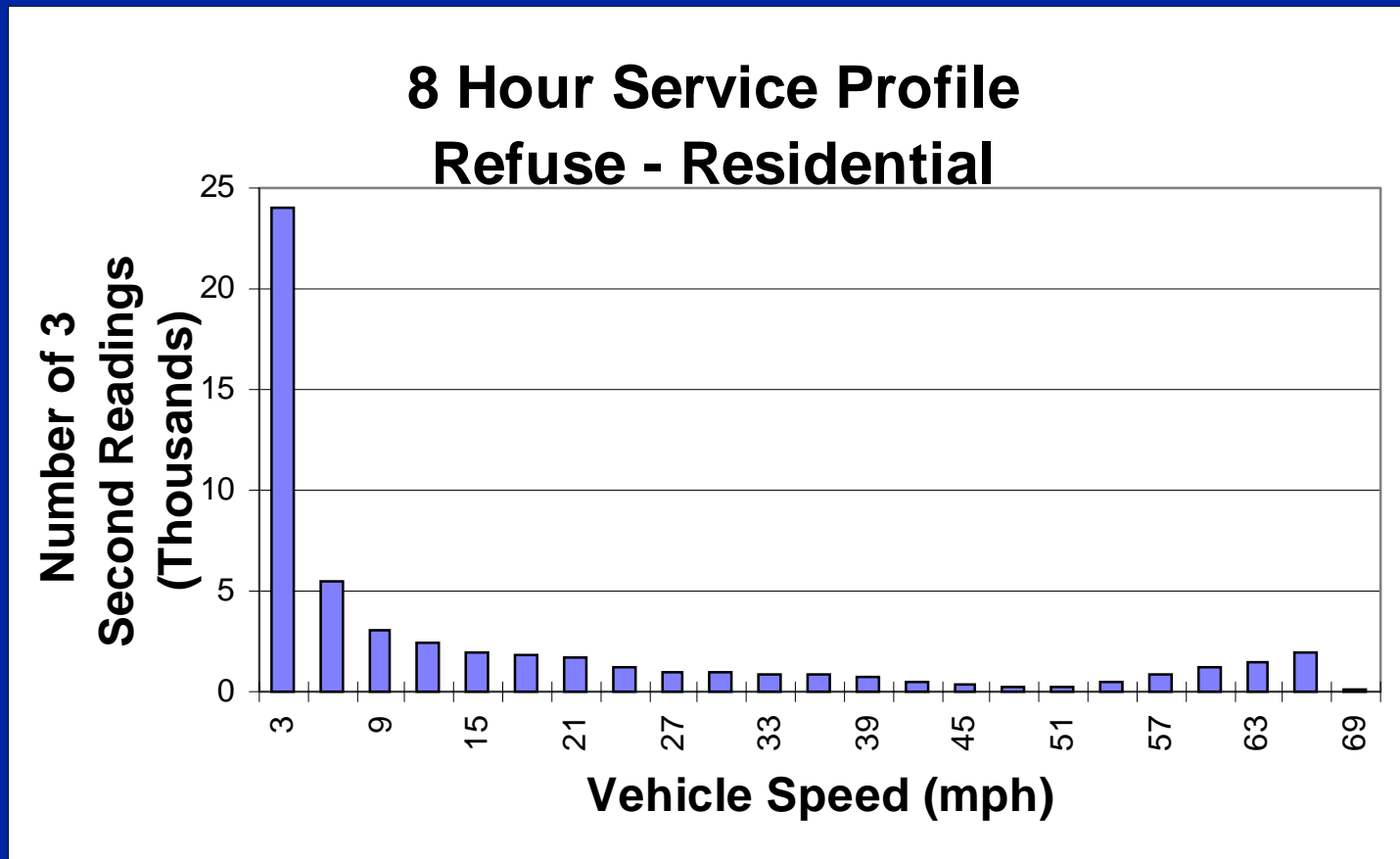
E7G 12L Engine



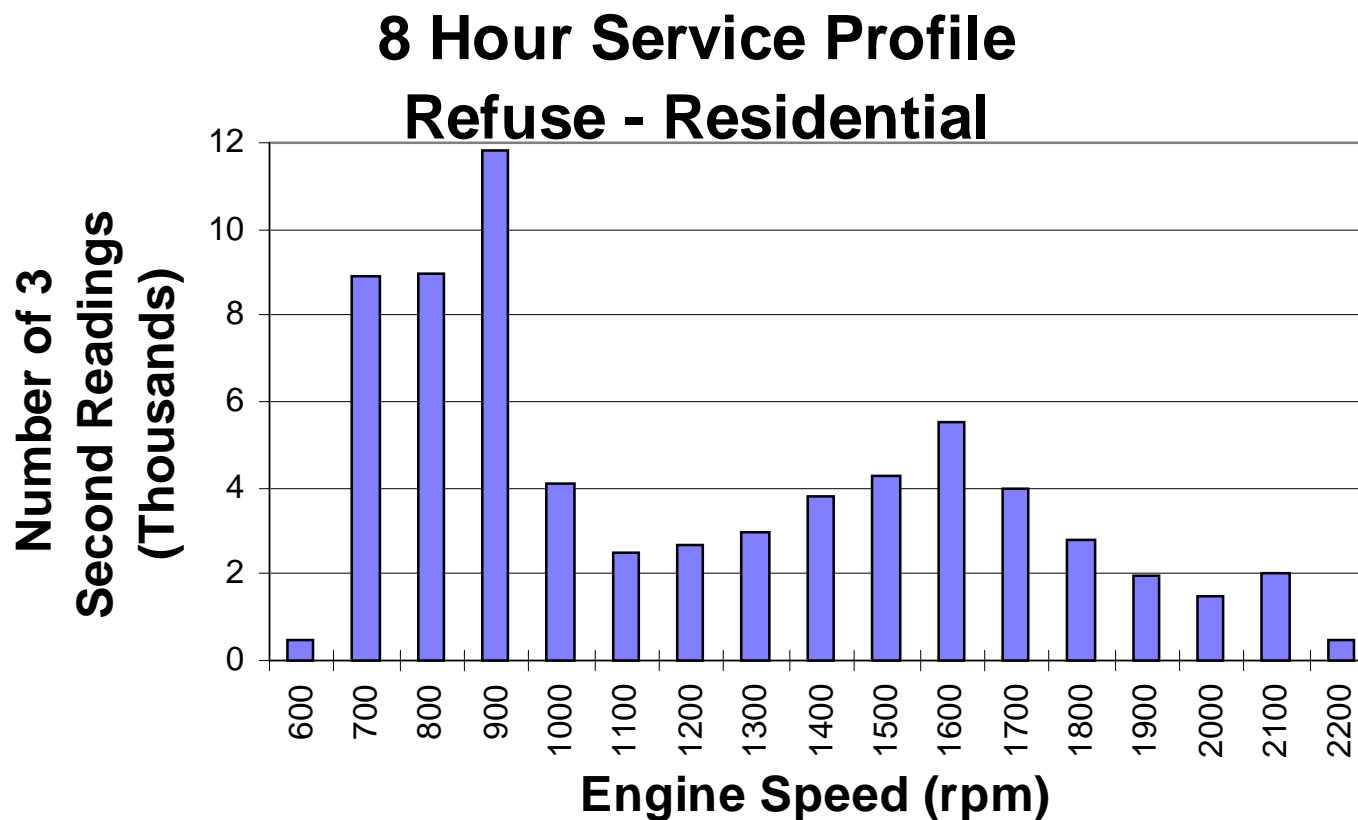
- ▼ ULEV Emission levels w/o Catalyst
 - ↻ < 2.0 gr/hp NO_x
 - ↻ < 2.5 gr/hp NO_x + MNHC
 - ↻ < .05 gr/hp hr PM goal
- ▼ In field service since December 1995



Refuse - Vehicle Speed



Refuse - Engine Speed





Service & Maintenance

- ▼ Use only Medium Ash Oil (.45-.64% ASH)
- ▼ Change LNG Fuel Filter Element Annually
- ▼ Double Platinum Tip Spark Plugs
 - ↻ Replace every 2000 hours or annually
- ▼ Adjust Valves every 2000 hours or annually



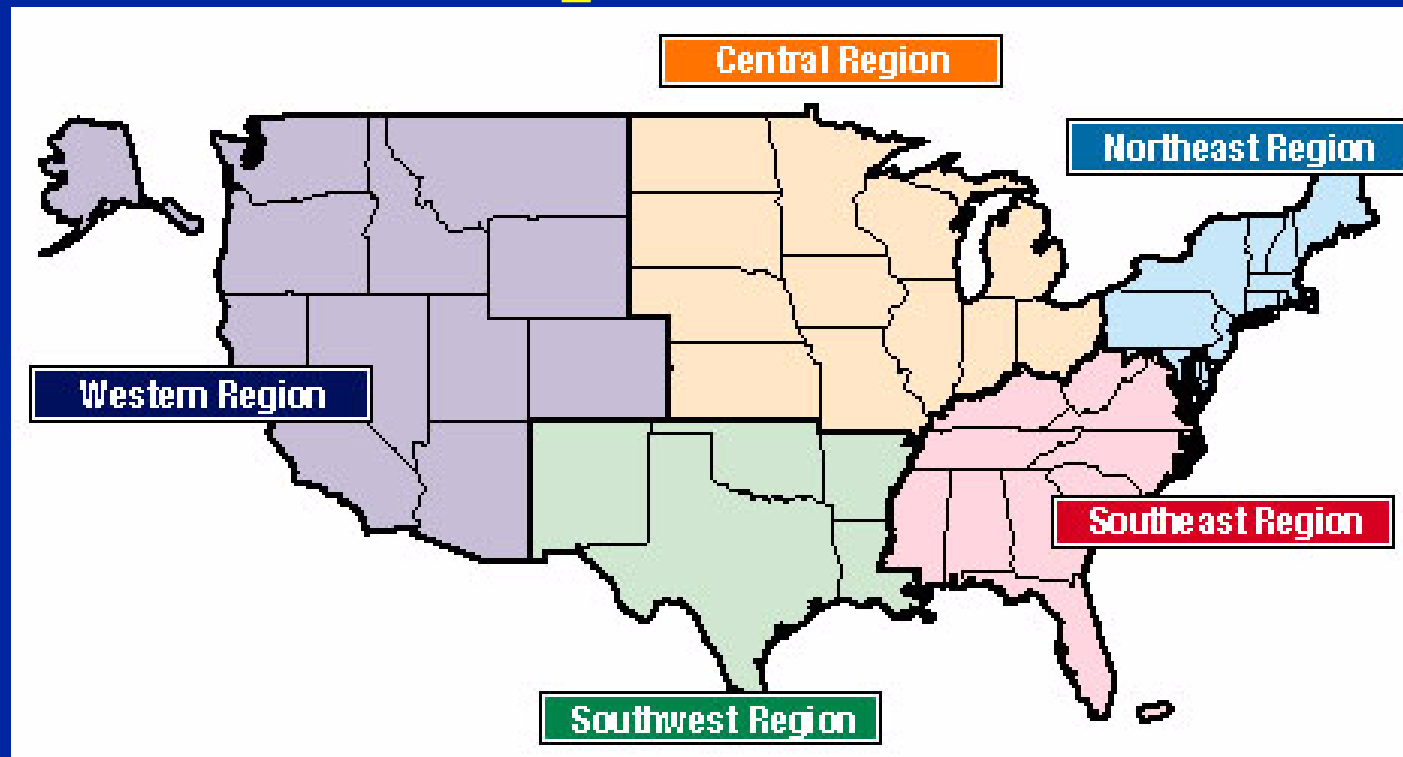


One Warranty Provider

Truck
Engine
Fuel System



Complete Service



- ▼ Subsidiaries - San Leandro & Anaheim
- ▼ Dealers/Service - California 24+ locations
- ▼ North America Dealers - 250 locations
- ▼ North America Service - 600 locations





MACK OEM Benefits



- ▼ **Heavy Duty Engine Builder**
- ▼ **Heavy Duty Chassis Builder**
- ▼ **Extensive Vehicle Testing**
- ▼ **Vehicle Warranty**
- ▼ **National Dealer Support**





Natural Gas Series



- ▼ Available MR & LE Models
- ▼ Available E7G Engine - 325 h.p.
- ▼ Vehicle Partnership - Single Source



Competition Clean Cities Display



**Volvo - Rolloff Dual Fuel
LNG & Diesel w/CAT Engine**



Kenworth LNG Tractor



**Crane Carrier CNG
(City of Long Beach, CA
3 Units)**



**Kenworth Tractor CNG Tank
Configuration "10 Tanks"**





MACK TRUCKS, INC.

**Wherever progress
is moving ahead,
listen for the steady
growl of a MACK
TRUCK.**

**THERE ARE NATIONS
THAT DON'T LAST THIS LONG.**

